010248

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

June 29, 2001

RECEIVED
JUL 06 2001

Mr. Lake H. Barrett, Acting Director
Office of Civilian Radioactive Waste Management
U.S. Department of Energy, Headquarters
1000 Independence Avenue, S.W.
Washington, DC 20585

Dear Mr. Barrett:

As you know, the U.S. Department of Energy (DOE) published a notice of availability, in the Federal Register on May 4, 2001, of a supplement to its draft environmental impact statement (DEIS) (hereafter referred to as the SDEIS), for a proposed geologic repository for the disposal of spent nuclear fuel and other high-level radioactive waste (HLW) at Yucca Mountain in Nevada. In the context of the Nuclear Waste Policy Act (NWPA), as amended, DOE is the lead agency for developing the proposed repository and considering potential environmental impacts. For its part, NRC is to adopt DOE's final environmental impact statement (FEIS), to the extent practicable, as part of any potential NRC licensing action related to the repository.

Consistent with its NWPA responsibilities and its role as a DEIS commenting agency, the NRC provided comments to DOE on its DEIS in a letter dated February 22, 2000. NRC's comments on the recently published SDEIS are enclosed. The enclosed comments and NRC's February 2000 comments on the DEIS are provided to ensure that the FEIS is more complete.

Please contact Charlotte E. Abrams, of my staff, if you have any questions about this letter or the enclosure. Ms. Abrams can be reached at (301) 415-7293.

Sincerely,

Martin J. Virgilio, Director
Office of Nuclear Material Safety
and Safeguards

Enclosure:
"U.S. NRC's Comments on U.S. DOE's Supplement to the Draft Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada"

cc: Dr. Jane R. Summerson

See attached list

-2-

Letter to L.H. Barrett from M. Virgilio dated: June 29, 2001 **010248**

cc:

R. Loux, State of Nevada	R. Massey, Lander County, NV
S. Frishman, State of Nevada	J. Pitts, Lincoln County, NV
L. Barrett, DOE/Washington, DC	M. Baughman, Lincoln County, NV
A. Brownstein, DOE/Washington, DC	A. Funk, Mineral County, NV
S. Hanauer, DOE/Washington, DC	J. Shankle, Mineral County, NV
C. Einberg, DOE/Washington, DC	L. Bradshaw, Nye County, NV
J. Carlson, DOE/Washington, DC	M. Murphy, Nye County, NV
N. Slater, DOE/Washington, DC	J. McKnight, Nye County, NV
L. Desell, DOE/Washington, DC	B. Price, Nevada Legislative Committee
E. Turner, DOE/Washington, DC	D. Weigel, GAO
D. Kim, DOE/Washington, DC	W. Barnard, NWTRB
S. Gomberg, DOE/Washington, DC	I. Navis, Clark County, NV
A. Gil, YMPO	E. von Tiesenhausen, Clark County, NV
R. Dyer, YMPO	L. Lehman, T-Reg, Inc
S. Brocoum, YMPO	R. Holden, NCAI
R. Clark, YMPO	A. Collins, NIEC
S. Mellington, YMPO	R. Arnold, Pahrump County, NV
C. Hanlon, YMPO	J. Larson, White Pine County
T. Gunter, YMPO	R. Clark, EPA
K. Hess, BSC	F. Marcinowski, EPA
D. Krisha, BSC	R. Anderson, NEI
S. Cereghino, BSC	R. McCullum, NEI
M. Voegele, BSC/SAIC	S. Kraft, NEI
S. Echols, Winston & Strawn	J. Kessler, EPRI
J. Curtiss, Winston & Strawn	D. Duncan, USGS
J. Meder, Nevada Legislative Counsel Bureau	R. Craig, USGS
A. Kalt, Churchill County, NV	W. Booth, Engineering Svcs, LTD
G. McCorkell, Esmeralda County, NV	N. Rice, NV Congressional Delegation
L. Fiorenzi, Eureka County, NV	T. Story, NV Congressional Delegation
A. Johnson, Eureka County, NV	J. Reynoldson, NV Congressional Delegation

2

-3- **010248**

A. Remus, Inyo County, CA
M. Yarbro, Lander County, NV
S. Joya, NV Congressional Delegation
J. Pegues, City of Las Vegas, NV

2001-04-09

3

010248

**U.S. NUCLEAR REGULATORY COMMISSION'S COMMENTS
ON THE U.S. DEPARTMENT OF ENERGY'S
"SUPPLEMENT TO THE DRAFT ENVIRONMENTAL IMPACT STATEMENT
FOR A GEOLOGIC REPOSITORY FOR THE DISPOSAL OF SPENT NUCLEAR FUEL
AND HIGH-LEVEL RADIOACTIVE WASTE
AT YUCCA MOUNTAIN, NYE COUNTY, NEVADA"**

This enclosure provides comments, by the U.S. Nuclear Regulatory Commission (NRC) staff, on the May 2001 supplement to the draft environmental impact statement (DEIS) (hereafter referred to as the SDEIS) prepared by the U.S. Department of Energy (DOE) for a proposed geologic repository for the disposal of spent nuclear fuel (SNF) and other high-level radioactive waste (HLW) at Yucca Mountain (Nye County), Nevada.

In its review of the SDEIS, NRC has four comments, as noted below, that address the following areas: identification of a Proposed Action; impacts from the design options; new or modified facilities associated with the Science and Engineering Report (S&ER) flexible design; and the assessment of radiological impacts associated with the S&ER flexible design.

Comment No. 1

1 Consistent with its February 2000 comments on the DEIS, the NRC staff believes that DOE's final environmental impact statement (FEIS) should more clearly define a Proposed Action for each component of the proposed activity.

Basis:
The environmental impact statement development process is intended to address a wide range of possible impacts of this complex geotechnical project. A significant amount of information, including multiple options for key components of the Proposed Action, was presented in the August 1999 DEIS (U.S. Department of Energy, 1999). However, as noted in its February 2000 comments on the DEIS, the NRC staff continues to believe that DOE's final environmental impact statement (FEIS) should more clearly define a Proposed Action comprised of: (i) a preferred option for each component; or (ii) a bounding analysis that provides a better understanding of the potential impact of each component, as well as their combined impacts. NRC recognizes the utility of DOE's preserving, to the extent possible, repository design flexibility, as outlined recently in the S&ER supporting the DEIS and the SDEIS. However, the DEIS did not identify a preferred option for each component of a possible geologic repository and the SDEIS does not define a preferred option for the design of a repository. Consequently, it is not clear that environmental impacts that could arise from a repository have been bounded.

Recommendation
In the interest of improving the focus of its National Environmental Policy Act analysis in its FEIS, DOE should prepare an appropriate analysis of a clearly defined Proposed Action, or provide sufficient information and analysis of the various operational approaches to demonstrate that the environmental impacts of the proposed repository are bounded.

Enclosure

4

010248

Comment No. 2

2... The SDEIS provides several new design and operational features proposed to meet thermal criteria. DOE should ensure that sufficient information is provided to enable assessment of the direct, indirect, and cumulative impacts.

Basis

In the SDEIS, DOE describes two thermal operational approaches to control temperature at the drift pillars and the waste package surface. For the high-temperature operation mode, at least some portion of the drift pillars would have temperatures above the boiling point of water. The low-temperature operating mode is designed to ensure temperatures below the boiling point at all times and waste package surface temperatures below 85 degrees Centigrade. To achieve either temperature scenario, DOE describes five potential operational approaches: increased drift spacing, increased preclosure ventilation, surface aging of commercial fuel, fuel blending, and variable line loading. Depending on the approaches selected, the operational and monitoring period may extend beyond 300 years, with as long as 50 years allowed for waste emplacement.

NRC recognizes the value of maintaining flexibility in selecting operational approaches to enhance repository performance. However, many combinations of the operational approaches are likely to achieve the overall thermal goals, and each combination is likely to have a different set of impacts. For example, lower rates of ventilation may require larger spacing between waste packages, which may, in turn, lead to a larger repository with a greater volume of excavated rock and an expansion of the repository closer to key features such as the high ground-water gradient area to the north and across an additional fault zone. Similarly, the flexible pre-closure ventilation design could increase radon release through the use of forced ventilation. Without a clear description of the preferred option or without estimating impacts explicitly for each option, there is no basis for concluding that the full range of impacts has been presented in the DOE analyses.

Several of the flexible design operational approaches include new features not considered in the DEIS. In some instances, the SDEIS analyses multiply DEIS impacts by a proportionality constant to obtain impacts associated with the S&ER flexible design. Because many of the impacts cited in the SDEIS are the result of new design features (e.g., surface-aging facility, titanium drip shields) and altered time frames in the various flexible operational approaches, an adequate technical basis is required for use of the proportionality constants. For example, it is not clear that the thermal effects imposed by the flexible design would be linear and therefore amenable to quantification based on a proportionality constant. Similarly, impacts from constructing and operating the surface-aging facility may be spread over as many as 50 years, and include the construction of concrete pads covering 200 acres, and fabricating and placing up to 4500 dry-storage canisters and casks on these pads (Mattsson, 2000; U.S. Department of Energy, 2001a, Table 3-11). These new features are substantive modifications of the DEIS design and individual and cumulative impacts may not scale in a linear fashion .

The full range of impacts of the new operational approaches are not addressed. Waste package emplacement is discussed in detail in the SDEIS (Section 2.3.3.3), but certain potential activities are not discussed. They include, for example: (i) loading dry storage canisters and casks for the SNF aging facility; (ii) removing pallets and waste packages for repair and re-emplacement; (iii) maintaining drifts, waste packages, and other engineered barriers; (iv) moving waste packages to adjust thermal load; (v) retrieving waste packages; (vi) installing and maintaining drip shields; and (vii) constructing and using performance-confirmation drifts. It is also not clear whether the impact assessments include off-normal

2

5

010248

2 cont. events, accidents, or other events outside of the base case. For example, the impacts from manufacturing and shipping as much as 60,000 metric tons of fabricated titanium drip shields are not fully addressed, nor is the potential for worker injury or exposure during drip-shield emplacement. The drip shield is a new design feature and is not addressed in the offsite impact analyses included in the DEIS.

Recommendation

The FEIS should include an analysis of impacts associated with all potential operational activities related to a preferred design option. As an alternative, the FEIS could estimate impacts separately for a suite of proposed operational approaches. The specific environmental concerns associated with each primary impact indicator should be identified. The FEIS should also provide a technical basis to demonstrate that the full range of direct, indirect, and cumulative impacts has been included in the analyses. In addition, the FEIS should improve the technical justification for the use of linear thermal load proportionality factors.

Comment No. 3

3 The S&ER flexible design includes new or modified facilities, land uses, and changes in infrastructure. Environmental impacts from construction and operation of these repository features are not included in the SDEIS. A more thorough impact assessment is necessary for major changes incorporated in the S&ER flexible design.

Basis

The SDEIS (Table S-2) indicates that environmental impacts associated with the S&ER flexible design include potentially significant changes in ground use, radon release, peak electrical power requirements, fossil fuel requirements, construction and demolition debris, and waste generation. Although the SDEIS provides a relatively thorough description of the different approaches to the potential design and operating bounds of the proposed S&ER flexible design, a detailed description of these new facilities and analyses of their environmental impacts has not been included.

Foremost among the new facilities is the proposed separate, at-surface fuel-aging area. As part of the lower-temperature, flexible-design operating mode, DOE has proposed placing younger fuel in a surface-aging area, to allow heat dissipation before underground disposal, as a method of controlling repository temperatures (U.S. Department of Energy, 2001a, p. 2-8). This facility would age as much as 40,000 MTHM (metric tons of heavy metal) of SNF (or about 60 percent of repository-destined waste) over a 50-year period (Id.). Aging time is directly related to potential impacts associated with surface storage of SNF; however, only limited impact analysis of this new design feature has been provided in either the SDEIS or the S&ER. There is a similar concern regarding the proposed blending pool in the waste-handling building with a proposed design capacity of 5000 MTHM (p. 2-15). It is not apparent that DOE has prepared an impact analysis of this major new design feature.

Other examples of new design features that lack adequate descriptions and impact assessments (i.e., land and water use, impact on ground-water quality) include the solar power generating facility, and the wind farm. The environmental impacts of all features of a proposed design, as well as alternatives, need to be identified and evaluated.

Recommendation

DOE should expand the description and environmental impact analyses for major new features of the S&ER flexible design in the FEIS.

-3-

6

010248

Comment No. 4

4 Estimates of the radiological impacts of the flexible design require additional technical basis.

Basis

The SDEIS (U.S. Department of Energy, 2001a, Section 3.1.7) states that "[e]xposed workers include both radiation workers and some general employees.... DOE used the total number of exposed worker-years to estimate potential impacts from the radiation dose received from this exposure, namely the number of latent cancer fatalities...." The SDEIS does not define the number of general employees, the lengths of their exposures, or the exposure levels associated with different phases of operation that were applied in estimating latent cancer fatalities.

In addition, the lower-temperature design option may require preclosure ventilation for a period beyond 300 years. Ensuring that the emplacement drifts remain clear and unobstructed from rockfall or drift collapse during this period is therefore important. The SDEIS does not appear to address the impacts of drift support system maintenance on worker exposure.

Recommendation

The FEIS should provide a more complete assessment of the radiological impacts of the flexible design, including maintenance activities associated with an extended preclosure period.

References

Mattsson, C.G., "Repository Surface Design Engineering Files Letter Report – Non-Boiling Repository Surface Facilities Conceptual Design," Letter from C.G. Mattsson (Civilian Radioactive Waste Management System Management and Operating Contractor) to K.J. Skipper (DOE/Yucca Mountain Site Characterization Office), July 21, 2000.

U.S. Department of Energy, "Draft Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada," DOE/EIS–0250D, North Las Vegas, NV: Office of Civilian Radioactive Waste Management, U.S. Department of Energy, 1999.

U.S. Department of Energy, "Supplement to the Draft Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada," DOE/EIS–0250D–S. North Las Vegas, NV: Office of Civilian Radioactive Waste Management, U.S. Department of Energy, 2001a.

U.S. Department of Energy, "Yucca Mountain Science and Engineering Report: Technical Information Supporting Site Recommendation Consideration. DOE/RW–0539. Washington, DC: Office of Civilian Radioactive Waste Management, U.S. Department of Energy, 2001b.

U.S. Nuclear Regulatory Commission, "U.S. Nuclear Regulatory Commission's Comments on U.S. Department of Energy's Draft Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-level Radioactive Waste at Yucca Mountain, Nye County, Nevada," Washington, DC: U.S. Nuclear Regulatory Commission, 1999.

7

RESPONSES TO U.S. NUCLEAR REGULATORY COMMISSION COMMENTS ON THE SUPPLEMENT TO THE DRAFT EIS (Comment Document 10248)

1. In the Draft EIS and the Supplement to the Draft EIS, DOE analyzed a variety of scenarios and implementing alternatives that it could deploy to construct, operate and monitor, and eventually close a repository at Yucca Mountain. The purpose of these scenarios and implementing alternatives, which reflect potential design considerations, waste packaging approaches, and modes for transporting spent nuclear fuel and high-level radioactive waste to the Yucca Mountain site, was to: (1) provide the full range of potential environmental impacts of the Proposed Action and No-Action Alternative; (2) reflect potential decisions, such as the mode of transport, that the EIS would support; and (3) retain flexibility in the design of the repository to maintain the ability to reduce uncertainties in or improve long-term repository performance, and improve operational safety and efficiency. The design and operation enhancements presented in the Supplement have been carried forward to the Final EIS.

   Many of the issues relating to how a repository would be operated and how the spent nuclear fuel and high-level radioactive waste would be packaged would be resolved only in the context of developing the detailed design for a possible license application. DOE cannot predict with certainty how it would eventually resolve these issues. However, to enable an improved understanding of the potential environmental impacts from a more specifically defined Proposed Action, DOE has identified its preferred alternatives, simplified aspects of the Proposed Action, and modified its analyses and presentation of information to illustrate the full range of potential environmental impacts likely to occur under any foreseeable mode of transportation, or repository design and operating mode. Thus, for example, DOE has identified rail as its preferred mode of transport both nationally and in Nevada, and demonstrated through analysis that the mostly truck and mostly rail national transportation scenarios provide the full range of environmental impacts.

   In the Final EIS, DOE has identified and analyzed a range of operating modes from higher- to lower-temperature. Chapter 2 of the EIS and other related sections of the Final EIS have been revised to reflect this refinement in design selection, which basically is an establishment of design fundamentals such as drift layout, drift spacing, depth and location of emplacement areas, and location of ventilation raises. The Final EIS describes a design for the repository with variations on the operating mode. The key parameters defining the flexible operating modes are waste package spacing, length of active ventilation, and waste package loading (principally the age of the fuel being emplaced). The range of variances in these parameters basically determine the extent of the repository design that will be utilized for emplacement of 70,000 metric tons of waste and fuel; the higher-temperature operating mode would require only the main central segment of the repository, several of the lower-temperature operating modes would use that segment and the western extension, while the "ultra" low-temperature operating mode would require use of the entire planned initial design.

2. In the Draft EIS, DOE evaluated a preliminary design based on the *Viability Assessment of a Repository at Yucca Mountain* (DIRS 101779-DOE 1998) that focused on the amount of spent nuclear fuel (and associated thermal output) that DOE would emplace per unit area of the repository (called areal mass loading). Areal mass loading was represented for analytical purposes in the Draft EIS by three thermal load scenarios: a high thermal load of 85 metric tons of heavy metal (MTHM) per acre, an intermediate thermal load of 60 MTHM per acre, and a low thermal load of 25 MTHM per acre. DOE selected these analytical scenarios to represent the range of foreseeable design features and operating modes, and to ensure that it considered the associated range of potential environmental impacts within the framework of a design the central feature of which was areal mass loading.

   Since DOE issued the Draft EIS, it has continued to evaluate design features and operating modes that would reduce uncertainties in or improve long-term repository performance, and improve operational safety and efficiency. The result of the design evolution process was the development of the flexible design that was evaluated in the Supplement to the Draft EIS and is evaluated in this Final EIS. This design focuses on controlling the temperature of the rock between the waste emplacement drifts (as opposed to areal mass loading) by varying other parameters such as the heat output per unit length of the emplacement drift and the distances between waste packages. Within this design framework of controlling the temperature of the rock, DOE selected these lower- and higher-temperature operating modes to represent the range of foreseeable design features and operating modes, and to ensure that it considered the associated range of potential environmental impacts (DOE recognizes that many of the short-term impacts tended to increase over those discussed in the Draft EIS).

In this Final EIS, DOE varied design parameters to create scenarios to illustrate lower- and higher-temperature operating modes in such a way as to provide the range of potential environmental impacts. Furthermore, to not underestimate the environmental impacts that could result from implementing any of the lower- or higher-temperature operating modes, DOE has relied on conservative, yet realistic, assumptions when uncertainties remain.

3. In this Final EIS, DOE has updated and expanded the description of the flexible design and associated facilities, as well as performed a complete analysis to describe the range of potential environmental impacts that could occur under the Proposed Action. The tables in Section 2.4 of the Final EIS demonstrate the bounding nature of the flexible operating modes within the construct of a fixed design.

4. In the Supplement to the Draft EIS total worker years are used as a primary impact indicator for occupational health and safety impacts. As noted on page 3-1, "The Department used the ratio of primary impact indicators to specific impacts in the Draft EIS to determine the Supplement impact estimates." Therefore, in the analysis the base ratio of involved (including radiation workers) workers to noninvolved (including general employees) workers was the kept the same as for the Draft EIS. The exposure [dose] levels used were the same as described in Appendix F of the Draft EIS. The total dose to each of these worker populations was changed accordingly for the total length flexible design being considered as compared to the Draft EIS high thermal load scenario. The additional time needed for repository monitoring and maintenance was included in the Supplement estimates. A complete analysis of worker impacts under the flexible design operating modes is presented in Section 4.1.7 of the Final EIS. Section 4.1.7.5 shows that over the duration of the project construction, operation and monitoring, and closure phases the dose to the maximally exposed worker is about the same as shown for the thermal load scenarios in the Draft EIS.

CONVERSIONS

METRIC TO ENGLISH			ENGLISH TO METRIC		
Multiply	**by**	**To get**	**Multiply**	**by**	**To get**
Area					
Square meters	10.764	Square feet	Square feet	0.092903	Square meters
Square kilometers	247.1	Acres	Acres	0.0040469	Square kilometers
Square kilometers	0.3861	Square miles	Square miles	2.59	Square kilometers
Concentration					
Kilograms/sq. meter	0.16667	Tons/acre	Tons/acre	0.5999	Kilograms/sq. meter
Milligrams/liter	1[a]	Parts/million	Parts/million	1[a]	Milligrams/liter
Micrograms/liter	1[a]	Parts/billion	Parts/billion	1[a]	Micrograms/liter
Micrograms/cu. meter	1[a]	Parts/trillion	Parts/trillion	1[a]	Micrograms/cu. meter
Density					
Grams/cu. cm	62.428	Pounds/cu. ft.	Pounds/cu. ft.	0.016018	Grams/cu. cm
Grams/cu. meter	0.0000624	Pounds/cu. ft.	Pounds/cu. ft.	16,025.6	Grams/cu. meter
Length					
Centimeters	0.3937	Inches	Inches	2.54	Centimeters
Meters	3.2808	Feet	Feet	0.3048	Meters
Kilometers	0.62137	Miles	Miles	1.6093	Kilometers
Temperature					
Absolute					
Degrees C + 17.78	1.8	Degrees F	Degrees F – 32	0.55556	Degrees C
Relative					
Degrees C	1.8	Degrees F	Degrees F	0.55556	Degrees C
Velocity/Rate					
Cu. meters/second	2118.9	Cu. feet/minute	Cu. feet/minute	0.00047195	Cu. meters/second
Grams/second	7.9366	Pounds/hour	Pounds/hour	0.126	Grams/second
Meters/second	2.237	Miles/hour	Miles/hour	0.44704	Meters/second
Volume					
Liters	0.26418	Gallons	Gallons	3.78533	Liters
Liters	0.035316	Cubic feet	Cubic feet	28.316	Liters
Liters	0.001308	Cubic yards	Cubic yards	764.54	Liters
Cubic meters	264.17	Gallons	Gallons	0.0037854	Cubic meters
Cubic meters	35.314	Cubic feet	Cubic feet	0.028317	Cubic meters
Cubic meters	1.3079	Cubic yards	Cubic yards	0.76456	Cubic meters
Cubic meters	0.0008107	Acre-feet	Acre-feet	1233.49	Cubic meters
Weight/Mass					
Grams	0.035274	Ounces	Ounces	28.35	Grams
Kilograms	2.2046	Pounds	Pounds	0.45359	Kilograms
Kilograms	0.0011023	Tons (short)	Tons (short)	907.18	Kilograms
Metric tons	1.1023	Tons (short)	Tons (short)	0.90718	Metric tons
ENGLISH TO ENGLISH					
Acre-feet	325,850.7	Gallons	Gallons	0.000003046	Acre-feet
Acres	43,560	Square feet	Square feet	0.000022957	Acres
Square miles	640	Acres	Acres	0.0015625	Square miles

a. This conversion is only valid for concentrations of contaminants (or other materials) in water.

METRIC PREFIXES

Prefix	Symbol	Multiplication factor
exa-	E	1,000,000,000,000,000,000 = 10^{18}
peta-	P	1,000,000,000,000,000 = 10^{15}
tera-	T	1,000,000,000,000 = 10^{12}
giga-	G	1,000,000,000 = 10^{9}
mega-	M	1,000,000 = 10^{6}
kilo-	k	1,000 = 10^{3}
deca-	D	10 = 10^{1}
deci-	d	0.1 = 10^{-1}
centi-	c	0.01 = 10^{-2}
milli-	m	0.001 = 10^{-3}
micro-	µ	0.000 001 = 10^{-6}
nano-	n	0.000 000 001 = 10^{-9}
pico-	p	0.000 000 000 001 = 10^{-12}